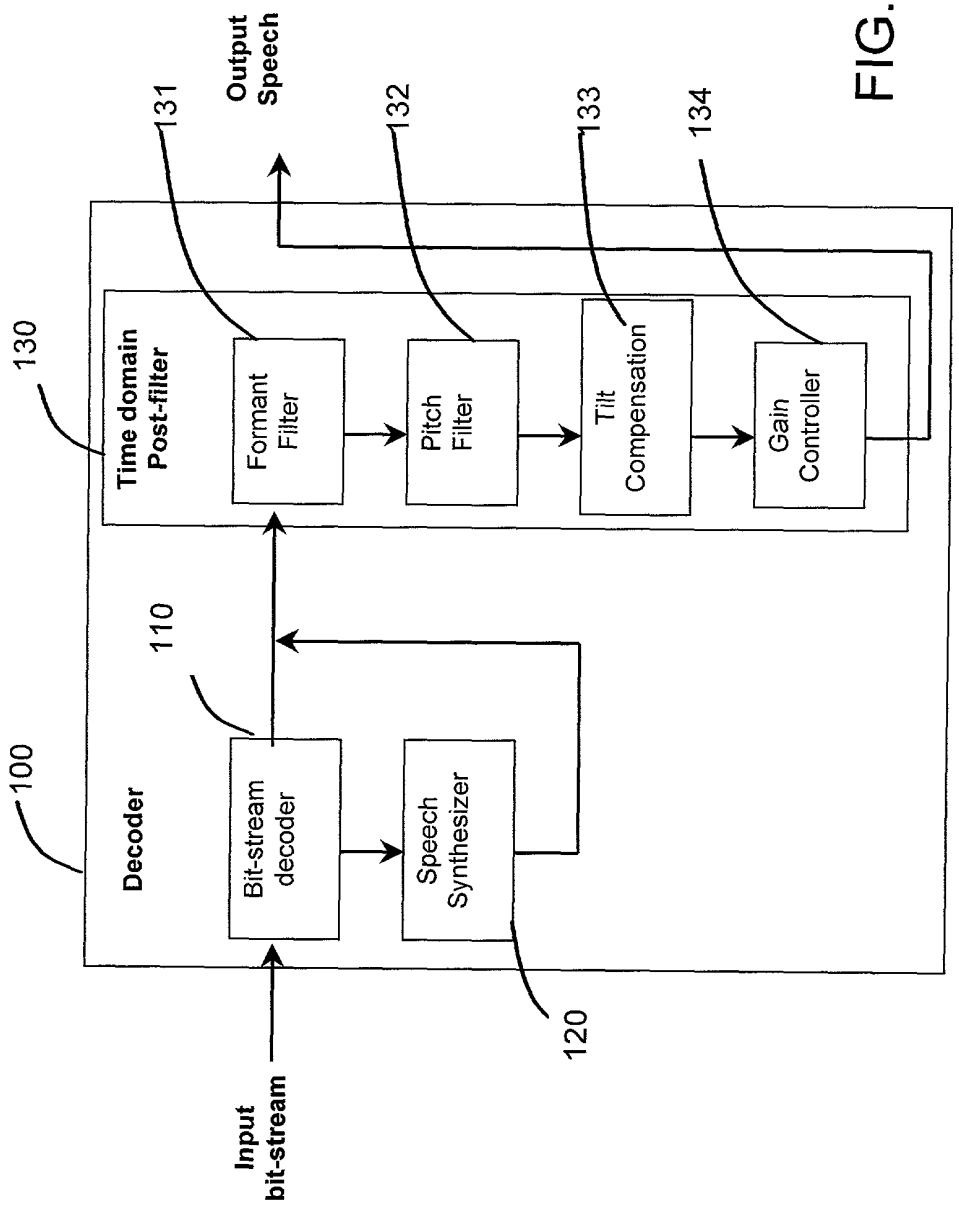

FIG. 1 Prior Art

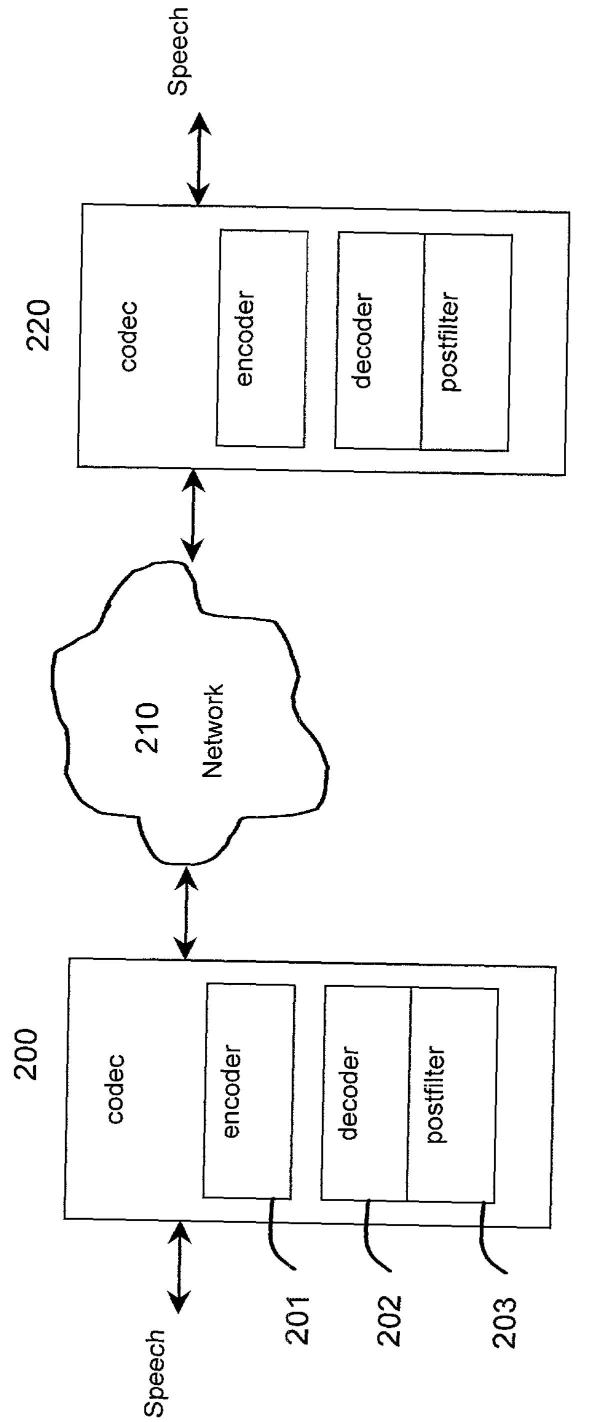
Speech
220
codec
encoder
decoder
postfilter
210
Network
200
codec
encoder
decoder
postfilter
Speech
201
202
203

FIG.2

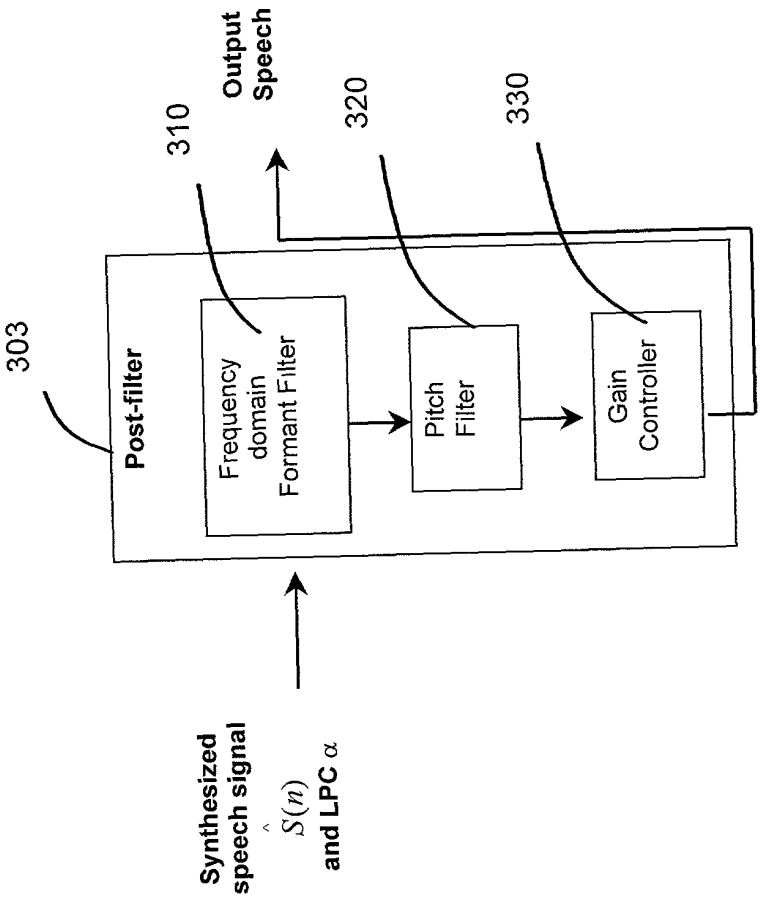
303
Post-filter
310
Frequency domain Formant Filter
320
Pitch Filter
330
Gain Controller
Output Speech
Synthesized speech signal
$\hat{S}(n)$
and LPC α

FIG. 3

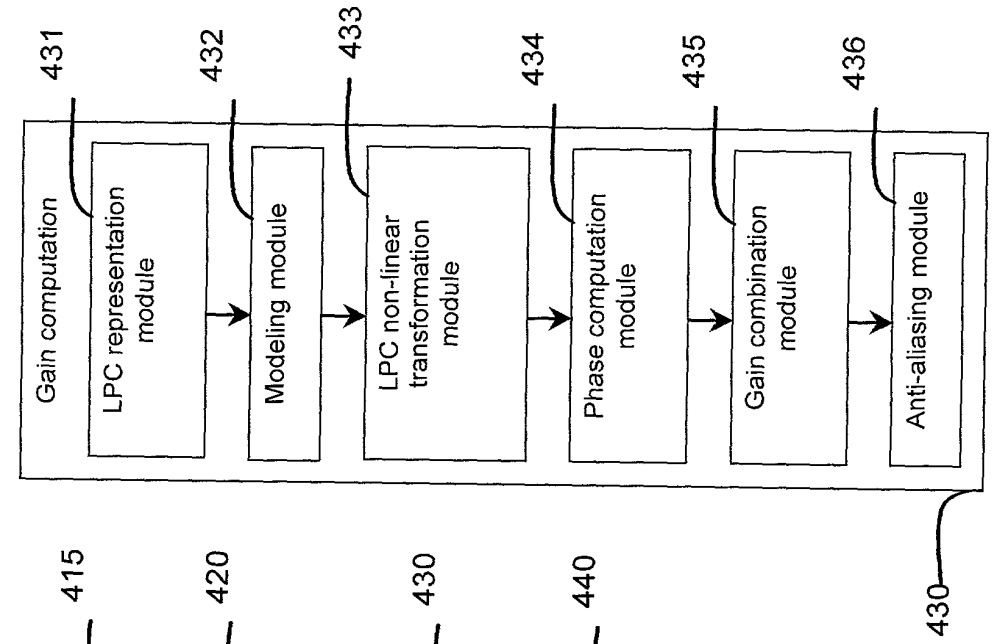

FIG.4c

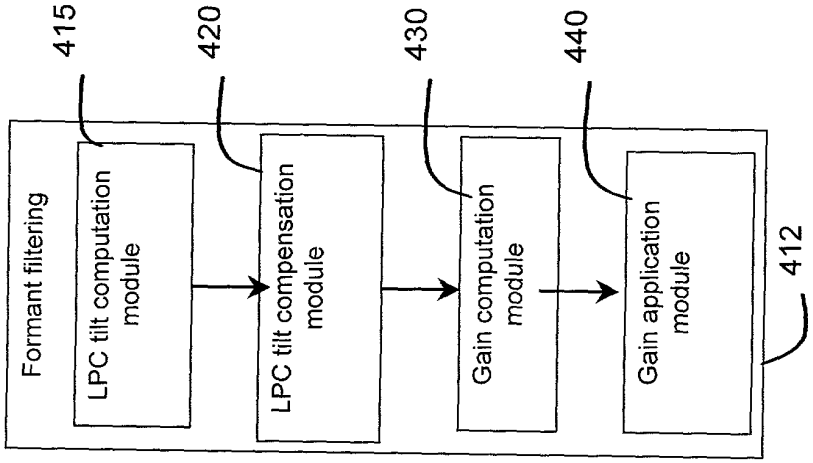

FIG.4b

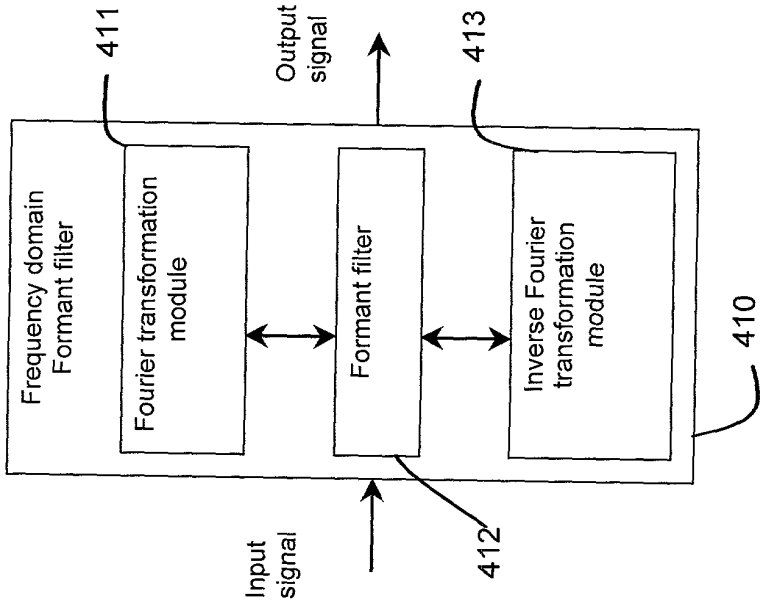

FIG.4a

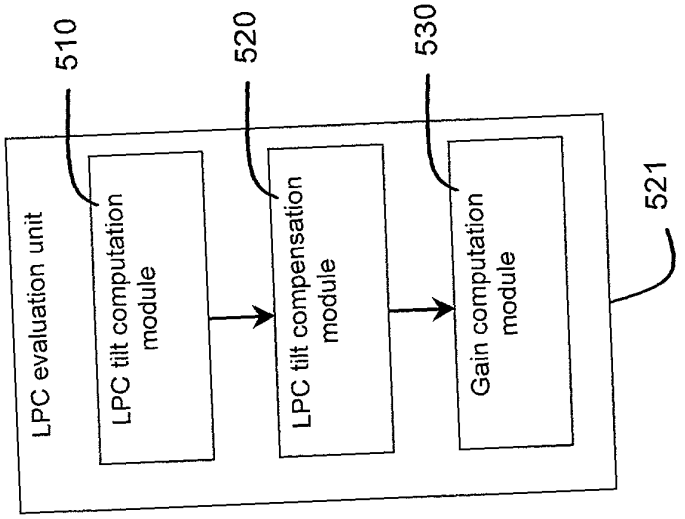
LPC evaluation unit
LPC tilt computation module
LPC tilt compensation module
Gain computation module
510
520
530
521

FIG.5b

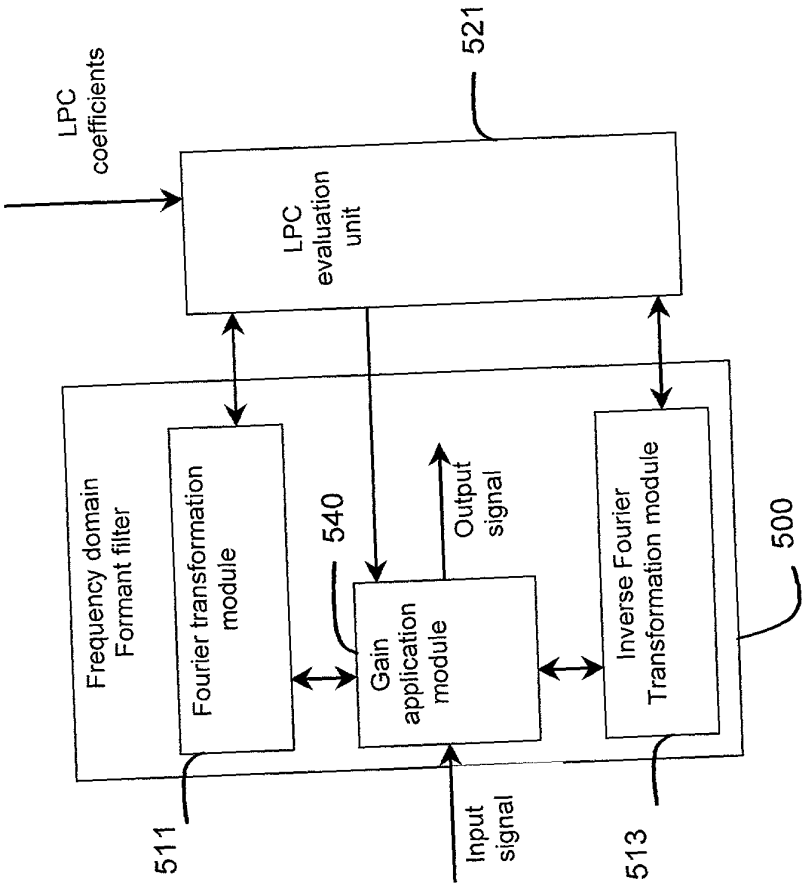
LPC coefficients
LPC evaluation unit
521
Frequency domain Formant filter
Fourier transformation module
Gain application module
Output signal
Inverse Fourier Transformation module
540
500
511
Input signal
513

FIG.5a

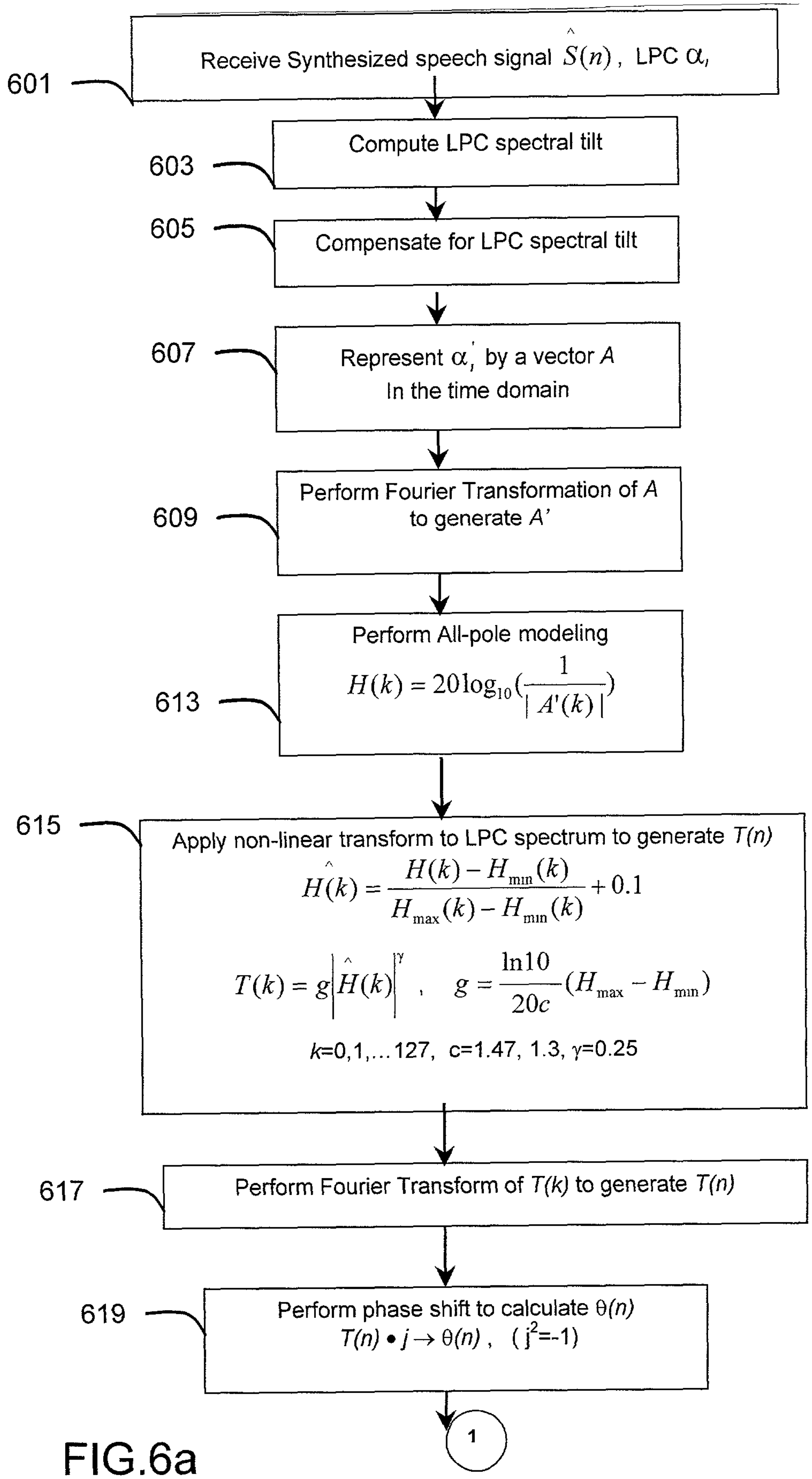
601
Receive Synthesized speech signal $\hat{S}(n)$, LPC α_i
603
Compute LPC spectral tilt
605
Compensate for LPC spectral tilt
607
Represent α_i' by a vector A
In the time domain
609
Perform Fourier Transformation of A to generate A'
613
Perform All-pole modeling
$H(k) = 20\log_{10}\left(\frac{1}{|A'(k)|}\right)$
615
Apply non-linear transform to LPC spectrum to generate $T(n)$
$\hat{H}(k) = \frac{H(k) - H_{min}(k)}{H_{max}(k) - H_{min}(k)} + 0.1$
$T(k) = g\left|\hat{H}(k)\right|^{\gamma}, \quad g = \frac{\ln 10}{20c}(H_{max} - H_{min})$
k=0,1,...127, c=1.47, 1.3, γ=0.25
617
Perform Fourier Transform of $T(k)$ to generate $T(n)$
619
Perform phase shift to calculate θ(n)
$T(n) \bullet j \rightarrow \theta(n)$, ($j^2=-1$)
1

FIG.6a

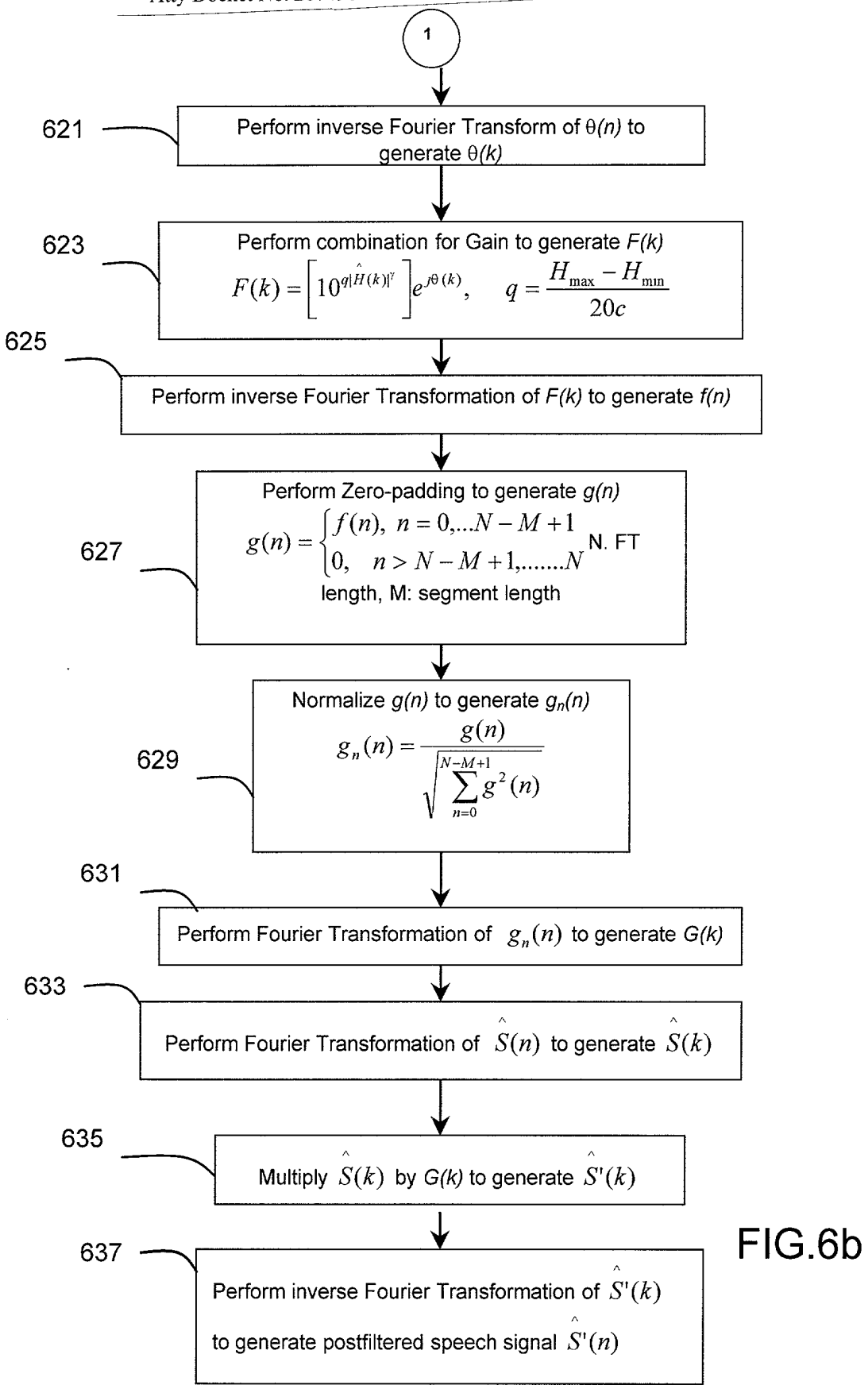
1
621
Perform inverse Fourier Transform of θ(n) to generate θ(k)
623
Perform combination for Gain to generate F(k)
$F(k) = \left[10^{q|\hat{H}(k)|^{\gamma}}\right] e^{j\theta(k)}, \quad q = \frac{H_{\max} - H_{\min}}{20c}$
625
Perform inverse Fourier Transformation of F(k) to generate f(n)
627
Perform Zero-padding to generate g(n)
$g(n) = \begin{cases} f(n), & n = 0,...N-M+1 \\ 0, & n > N-M+1,.....N \end{cases}$
N. FT length, M: segment length
629
Normalize g(n) to generate $g_n(n)$
$g_n(n) = \frac{g(n)}{\sqrt{\sum_{n=0}^{N-M+1} g^2(n)}}$
631
Perform Fourier Transformation of $g_n(n)$ to generate G(k)
633
Perform Fourier Transformation of $\hat{S}(n)$ to generate $\hat{S}(k)$
635
Multiply $\hat{S}(k)$ by G(k) to generate $\hat{S}'(k)$
637
Perform inverse Fourier Transformation of $\hat{S}'(k)$
to generate postfiltered speech signal $\hat{S}'(n)$

FIG.6b

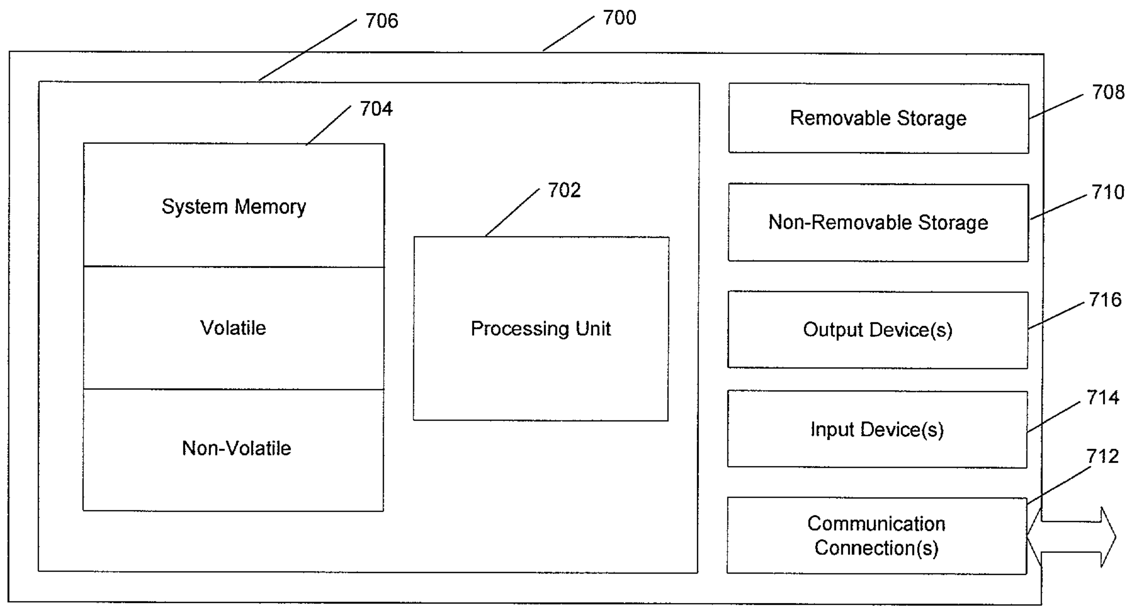
706
700
704
System Memory
Volatile
Non-Volatile
702
Processing Unit
Removable Storage
708
Non-Removable Storage
710
Output Device(s)
716
Input Device(s)
714
Communication Connection(s)
712

FIG.7